CHAPTER 9. VHF/UHF AIR/GROUND COMMUNICATIONS FREQUENCY ENGINEERING

900. PURPOSE. The purpose of this chapter is to present an overview of the frequency engineering necessary for A/G communications in the VHF and UHF bands. The detailed frequency engineering for this function is found in the appendix.

901. COMMUNICATIONS FREQUENCY ALLOCATIONS. All voice communications for ATC utilizes AM in the bands:

118.000 - 136.975 MHz*

225.000 - 328.600 MHz#

335.400 - 400.000 MHz#

* Portions are not available to FAA. See the appendix.

Only some frequencies are usable by FAA for military communications, pilot-to-controller. See the appendix.

902. BASIC PRINCIPLES OF COMMUNICATIONS FREQUENCY ENGINEERING. Due to the fixed number of frequencies available for communications facilities, each communications frequency is reused as often as possible throughout the country. Communications frequency engineering provides an interference-free environment for each facility within its FPSV. There are several different functions for communications and each has its own FPSV, defined in the appendix. Communications frequency engineering involves three analysis disciplines: intersite (cochannel), adjacent channel and cosite.

a. Intersite analysis is necessary to prevent radio frequency interference (RFI) between facilities providing service on the same frequency at different geographic locations. The basic factors considered in intersite analysis are the Radio Line of Sight (RLOS) and the ratio between Desired (D) and Undesired (U) signal levels (D/U), as seen at the airborne receiver input. All communications frequency assignments shall be engineered to meet a cochannel D/U of 5:1, i.e., 14 dB.

b. Adjacent channel analysis is necessary to prevent RFI resulting from the close location of two FPSV's with frequency separations of only 25 kHz. The basic method is to separate FPSV's so that they do not overlap, plus a small additional protective distance.

c. Cosite analysis is necessary to prevent RFI resulting from the interaction of transmitter and receivers at or near the same site, which may be far removed in frequency. Cosite RFI includes intermodulation, cross-modulation, harmonic, overload and AM/FM/TV broadcast interference.

903. COMMUNICATIONS FREQUENCY ENGINEERING METHODS. Intersite analysis consists of two basic methods for determining whether a proposed frequency meets the

required D/U ratio criteria.

a. Intersite analysis. Path loss between the D/U facilities is determined at the critical point and the D/U ratio or the RLOS value is established. This intersite analysis method is discussed in the appendix.

b. Adjacent channel analysis. Since some frequency separation does exist, path loss is not as critical as with cochannel intersite frequencies. The critical points are determined and must be separated by 0.6 nmi or more. This adjacent channel analysis method is discussed in the appendix.

c. Cosite analysis. Cosite analysis is used to prevent interference by interaction with other transmitters at or near the FAA site. These sources can be FAA equipment in the same building, or high power or broad spectrum emissions from a few miles away. A discussion of the problems and remedies of cosite interference is found in the appendix.

904. SPECIAL ISSUES TO BE CONSIDERED.

a. Ground transmitter power is normally at a level of 10 watts (W). Linear amplifiers of 50 W may be used only for service radii that are over 60 nmi, or in particularly difficult terrain where there are AT operational problems.

b. UHF coverage is less than VHF, even for the same power. When the service radius exceeds 100 nmi, power available (limits of coverage) curves must be checked carefully.

c. Aircraft transmitter power differs between aircraft. For practical frequency engineering, all aircraft are assumed to have the same output Effective Isotropic Radiated Power (EIRP) as that of the ground transmitter.

d. FM and TV broadcast interference, primarily from receiver overload (desensitization) is an increasing concern. The FMO shall carefully check the proximity for the presence of such transmitters during frequency engineering process. This is discussed in detail in the appendix.

e. Slant range is the actual distance between the ground transmitter and an aircraft at any critical point, with the radial distance and the altitude of the aircraft each forming a leg of a triangle. The hypotenuse is the actual distance, or slant range. However, because of the shape of most FPSV's, there is negligible difference between the slant range and the ground radial distance, so the service radius is always considered as a ground radial.

f. Antenna coverage is effected by lobing of antenna radiation. Within limits, the LOWER the VHF or UHF antenna with respect to ground level, the better the overall coverage. This is very evident in the appendix.

g. At some "problem" sites, e.g., where there is limited real estate for adequate antenna separation or other constraints, FMO's may be required to consider multicouplers and/or combiners to prevent frequency interference. The following policy addresses the use of

multicouplers and/or combiners.

(1) ASR will manage the overall program for requirements and budgetary purposes.

(2) FMO's will validate the requirements for multicoupler/combiners at sites within their regions in coordination with the Regional Associate Program Manager (RAPM).

(3) FMO's must carefully specify requirements for multicouplers and combiners. Whereas multicouplers are somewhat flexible in their potential for retuning to meet changing requirements, the combiner can tune only within a very narrow range of operating frequencies.

(4) FMO's shall note use of multicouplers/combiners in the GMF remarks section using the appropriate format.

905. AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS) VOICE OUTLET ASSIGNMENT CRITERIA. The following criteria will be used to the maximum extent possible in selecting ATIS voice outlets:

a. Priority for selecting a frequency to support ATIS broadcasts:

(1) VOR or VOR with tactical air navigation capability (VORTAC), except if they are Doppler-type, provided the VOR or VORTAC is located within three nautical miles of the airport. This only applies to those VOR's that do not currently provide other broadcast signals such as Enroute Flight Advisory System (EFAS).

(2) VOR test facility (VOT) for departure ATIS only.

(3) A 25 kHz discrete VHF air-ground frequency (for service to the military, any 25 KHz discrete UHF air-ground communications channel in the band 225-400 MHz). To minimize the potential for interference, the following two frequencies have been designated specifically for ATIS use and must be considered before any other discrete frequency in the 118-137 MHz band:

119.675 MHz
120.625 MHz

b. Power output of an ATIS operating on a discrete VHF or UHF channel should not exceed 10 W.

c. Service volume of an ATIS operating on a discrete VHF or UHF channel is normally limited to 60 nmi and 25,000 feet AGL. Requirements in excess of this value must be approved by the regional Air Traffic Division (ATD).

d. Frequency protection ratio (D/U) for an ATIS operating on a discrete VHF or UHF channel shall be a minimum of:

(1) 14 dB from an aircraft at the edge of the ATIS service volume to another

cochannel ATIS, Automated Weather Observing System (AWOS) or Automated Surface Observation System (ASOS).

(2) Beyond RLOS separation from a potential interferer at the edge of an FPSV to the transmitter site of the ATIS.

NOTE: The minimum separation is inclusive, i.e., both (1) and (2) must be met).

(e) If the proposed ATIS facility does not conform to subparagraphs (1) through (4) above, the FAA may not assign the system a broadcast frequency.

906. AWOS/ASOS FREQUENCY ASSIGNMENT CRITERIA. The following criteria will be used to the maximum extent possible in selecting AWOS/ASOS voice outlets:

(a) Priority for selecting a frequency to support AWOS/ASOS broadcasts:

(1) At airports with towers, the AWOS/ASOS shall utilize the existing ATIS voice outlet, if available. If the tower operates part-time, the AWOS/ASOS shall operate independently of the ATIS during non-operational hours.

(2) At airports without ATIS, when the AWOS/ASOS facility will be within 3 nmi of a non-Doppler VOR or VORTAC site, the AWOS/ASOS shall transmit weather information over the VOR frequency. This only applies to those VOR's that do not currently use the facility for other broadcast signals such as EFAS.

(3) If a VOR is not available, when the AWOS/ASOS facility will be within 3 nmi of an NDB, the NDB shall be modified for voice and the AWOS/ASOS placed on the NDB frequency. This does not apply to two-frequency NDB's which are not capable of voice transmission. A frequency change will be required if the existing NDB frequency is not in the 412 to 535 kHz range.

(4) If no NDB is available, the AWOS/ASOS facility shall be assigned a discrete 25 kHz air/ground frequency. To minimize the potential for interference, the following ten frequencies have been designated specifically for AWOS/ASOS use and must be considered before any other discrete frequency in the 118-137 MHz band:

118.325 MHz	119.925 MHz
118.375 MHz	120.000 MHz
118.525 MHz	121.125 MH
119.025 MHz	124.175 MHz
119.275 MHz	128.325 MHz

b. Power output of an AWOS/ASOS operating on a discrete VHF channel should not exceed 2.5 W.

c. Service volume of an AWOS/ASOS operating on a discrete VHF is normally limited to 25 nmi and 10,000 feet AGL. Requirements in excess of this value must be approved by the

regional ATD. Under no circumstances shall the radius of the service volume exceed the terminal control area.

d. Frequency protection ratio (D/U) for an AWOS/ASOS operating on a discrete VHF channel shall be a minimum of:

(1) 14 dB from an aircraft at the edge of the AWOS/ASOS service volume to another co-channel ATIS, AWOS or ASOS.

(2) Beyond RLOS separation from a potential interferer at the edge of an FPSV to the transmitter site of the AWOS/ASOS. **NOTE**: The minimum separation is inclusive, i.e., both (1) and (2) must be met.)

e. A letter of justification is submitted by the sponsor to the appropriate FMO identifying the need for a discrete VHF frequency.

f. If the proposed AWOS/ASOS facility does not conform to the requirements in subparagraphs (a) through (e) above, the FAA may not assign the system a broadcast frequency.

g. It is highly encouraged that ATC assignments using any of the above frequencies be moved to another channel at the first practical opportunity. AWOS, ASOS, or ATIS assignments outside of the above listed frequencies need not be changed. However, if operational necessities require a frequency change, the new assignment should be made from the above channel plan.

907. thru 999. RESERVED